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# Sewage Treatment Plant

## Facility Environmental Monitoring Report

Calendar Year 2004



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## **Brookhaven National Laboratory Sewage Treatment Plant Facility Environmental Monitoring Report Calendar Year 2004**

### ***Summary of Results***

*During 2004, there were six SPDES permit excursions at Outfall 001 (STP Effluent). In April and May, one of the two monthly grab samples exceeded the permit limit of 5 µg/L for methylene chloride. An investigation found that the analytical laboratory performing these analyses had a solvent contamination problem. Two permit exceedances of the total iron concentration of 0.37 mg/L occurred in June. In addition, the two composite samples collected in June, exhibited total suspended solids concentrations of 18 and 10 mg/L. Due to the elevated concentrations, the average TSS concentration and the calculated percent removal exceeded the permit limits. An investigation into the exceedances found that the sample collection probe was lying on the bottom of the flow channel and was likely collecting sediment resulting in the permit exceedances.*

*Groundwater monitoring results indicate only minor impacts to groundwater quality from STP filter bed operations. Sodium, iron, and aluminum levels exceeded the ambient water quality standard in four filter bed area monitoring wells. Low levels of nitrates were also detected, but at concentrations below applicable water quality standards. No volatile organic compounds or radionuclides related to Laboratory operations were detected in the groundwater samples.*

*Environmental TLD ambient dose measurements in the vicinity of the STP indicated that the dose was equivalent to natural background values.*

## **Background**

The Sewage Treatment Plant (STP) processes sanitary sewage for BNL facilities. The plant processes an average of 0.3 million gallons per day (MGD) during non-summer months and approximately 0.5 MGD during the summer. Treatment of the sanitary waste stream includes primary clarification to remove settleable solids and floatable materials; aerobic oxidation for secondary removal of the biological matter and nitrification of ammonia; secondary clarification; sand filtration for final effluent polishing; and ultraviolet disinfection for bacterial control prior to discharge into the Peconic River. Biological removal of nitrogen is accomplished by regulating the oxygen levels during the treatment process, and forcing the bacteria to use nitrate-bound oxygen for respiration. The discharge is regulated under a New York State Department of Environmental Conservation (NYSDEC) State Pollution Discharge Elimination System (SPDES) permit (NY-0005835).

Wastewater from the STP clarifier is released to the sand filter beds, where the water percolates through three feet of sand before being recovered by an underlying clay tile drain system, which transports the water to the discharge point at the Peconic River

(SPDES Outfall 001). Approximately 15 percent of the water released to the filter beds is lost either to evaporation or to direct groundwater recharge. At the present time, six sand filter beds are used in rotation.

There are two emergency hold-up ponds east of the sand filter bed area. They are used for the emergency storage of sanitary waste in the event of an upset condition or if the influent contains contaminants in concentrations exceeding BNL administrative limits or SPDES permit effluent release criteria. The hold-up ponds are equipped with fabric reinforced plastic liners that are heat-welded along all seams. The first lined hold-up pond was constructed in 1978 and has a capacity of approximately 4 million gallons. A second 4-million-gallon lined pond was constructed in 1989, for a combined capacity of nearly 8 million gallons. The combined capacity of the hold-up ponds provides the Laboratory with the ability to divert all sanitary system effluent for approximately 16 days. The liners were reconstructed as part of the Phase III sanitary upgrades completed in 2002. The new liners are of double-wall construction with a geotextile mesh between two layers of geomembrane. The liners are sloped to a low point that is equipped with a liquid sensor, which would detect liner leakage.

## Environmental Monitoring Program

BNL has established an environmental monitoring program at the STP to evaluate potential impact to environmental quality and to demonstrate compliance with DOE requirements and applicable federal, state, and local laws, regulations, and permits. The primary monitoring program is conducted in accordance with BNL's SPDES permit. BNL also uses groundwater monitoring to provide a secondary means of evaluating potential impacts of STP operations. The environmental monitoring program for the STP is described in the *BNL Environmental Monitoring Plan* (BNL 2004). The monitoring programs specifically designed for the STP area are summarized below, along with 2004 results.

## Monitoring Results

### SPDES Monitoring

Sanitary and process wastewaters generated by Laboratory operations are conveyed to the STP for treatment prior to discharge to the Peconic River. The STP provides tertiary treatment of sanitary and process wastewater (i.e., biological reduction of organic matter and reduction of nitrogen). This treatment process became fully functional in 1998.

The locations of SPDES monitoring points are presented in Figure 1. A summary of the CY 2004 monitoring results for the STP discharge at Outfall 001 is provided in Table 1.

While the STP discharge complies with SPDES permit limits more than 99 percent of the time, periodic excursions are noted annually. In 2004, there were six excursions of SPDES limits. On April 2, 2005 and May 3, 2005 grab samples of discharge from

Outfall 001 exceeded the permit limit of 5 µg/L for methylene chloride. An investigation found that the analytical laboratory performing these analyses had a solvent contamination problem. Two permit exceedances of the total iron concentration of 0.37 mg/L occurred on June 4, 2005 and June 7, 2005. In addition, two composite samples collected on the same dates, exhibited total suspended solids concentrations of 18 and 10 mg/L respectively. Due to the elevated concentrations, the average TSS concentration and the calculated percent removal exceeded the permit limits of 10 mg/L and 85 percent respectively. An investigation into the exceedances found that the sample collection probe was lying on the bottom of the flow channel and was likely collecting sediment. Samples collected after repositioning of the sample probe had significantly lower metal concentrations.

Whole effluent toxicity testing was not required by the BNL SPDES permit for 2004 because there was no toxicity exhibited for either the water flea nor the minnow in the four tests conducted in 2003. Testing will resume in 2005.

### **Radiological Monitoring**

The STP effluent is sampled at the output of the primary clarifier (Station DA) and at the Peconic River Outfall (Station EA). At each location, samples are collected three times per week on a flow-proportional basis; that is, for every thousand gallons (3,780 L) of water treated, approximately 4 fluid ounces (125 mL) of sample are collected and composited into a 5-gallon (18.9 L) collection container. These samples are analyzed for gross alpha and gross beta activity and tritium concentrations. Samples collected from these locations are composited and also analyzed for gamma-emitting radionuclides and strontium-90 on a monthly basis. The frequency of radiological monitoring was reduced to three times per week in November of 2001, due to the reduced source term of radionuclides with the shutdown of the High Flux Beam Reactor and the Brookhaven Medical Research Reactor.

The Safe Drinking Water Act (SDWA) specifies that no individual may receive an annual dose greater than 4 mrem (40 µSv) per year from radionuclides present in drinking water. Although the Peconic River is not used as a direct source of potable water, BNL applies the stringent drinking water standards for comparison purposes, in lieu of DOE wastewater criteria. Under the SDWA, the annual average gross alpha activity limit is 15 pCi/L (0.6 Bq/L) (including radium-226, but excluding radon and uranium). At the end of 2003, the SDWA was changed and the 50 pCi/L (1.85 Bq/L) gross beta activity screening level was removed. However, samples collected from Station EA have been analyzed for gross beta activity and the values obtained were compared against historical discharges. Other SDWA-specified drinking water limits are 20,000 pCi/L (740 Bq/L) for tritium and 8 pCi/L (0.3 Bq/L) for strontium-90. For all other radionuclides, Derived Concentration Guides (DCGs) found in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, (DOE, 1990) are used as reference values to maintain radionuclide concentrations well below the 4 percent of the DCG value for ingestion, which, if continuously ingested over a calendar year, would produce an effective dose equivalent of 4 mrem ( $4 \times 10^{-5}$  Sv).

Gross activity (alpha and beta) measurements were used as a screening tool for detecting the presence of radioactivity. Annual average gross alpha and beta activity in the STP effluent has remained consistent for many years with levels at control locations off site, on the Peconic and Carmans Rivers. This continued to be the case during 2004. The average gross alpha and beta activity at the STP Outfall 001 during this time was  $0.7 \pm 0.3$  pCi/L (0.03 Bq/L) and  $4.6 \pm 0.3$  pCi/L (0.2 Bq/L), respectively. Figures 2 and 3 provide the gross alpha and gross beta concentration trends in the STP effluent to the Peconic River for 2004.

Tritium detected at the STP originates either from HFBR sanitary system releases or small, infrequent batch releases from other BNL facilities that meet BNL discharge criteria. Tritium continues to be released from the HFBR at very low concentrations due to evaporative losses of primary coolant and condensation within the air conditioning units. Figure 4 provides the tritium concentration trend in the STP effluent to the Peconic River for 2004.

For 2004, the average tritium concentration measured at the STP outfall (EA, Outfall 001) was  $86 \pm 21$  pCi/L. This value is below the average MDL of 293 pCi/L. The maximum concentration of tritium was 460 pCi/L. A total source term of 0.05 Ci of tritium was released during the year. As seen in Figure 5, this is a small release compared with operational years of the HFBR. Reduced concentrations of tritium are primarily the result of operations readying the HFBR for permanent closure. Levels of tritium released to the STP are expected to further decline as the HFBR and BMRR move into permanent decommissioning.

Gamma spectroscopy analysis of the monthly STP composite samples for radionuclides did not detect any nuclides attributable to BNL operations, including cesium-137. The absence of this nuclide is being attributed to environmental restoration activities, which removed sand filter media that contained low levels of cesium.

## **Groundwater**

Six wells are used to monitor groundwater quality in the filter bed area and three wells are monitored in the holding pond area (Figure 6). Groundwater monitoring results for 2004 indicate only minor impacts to groundwater quality from STP operations.

### **Radiological Analyses**

Radioactivity levels in samples collected from the STP wells during 2004 were generally typical of ambient (background) levels (Table 2). Tritium was not observed in any of the STP monitoring wells.

### **Non-radiological Analyses**

During 2004, all water quality and most metals concentrations were below the applicable New York State Ambient Water Quality Standard (NYS AWQS) or drinking water standards. Sodium, iron and aluminum were occasionally detected at concentrations above water quality standards in several of the filter bed area wells (Table 4). Sodium

was detected in wells 039-86 and 039-87, at a maximum concentration of 373 mg/L (NYS AWQS is 20 mg/L). Iron was detected in two wells 038-03 and 038-08, with a maximum concentration of 1.18 mg/L (NYS AWQS is 0.3 mg/L) and aluminum was detected in well 039-08 at a concentration of 0.4 mg/L (secondary drinking water standard is 0.2 mg/L). Nitrates were detected in most STP area wells, with a maximum concentration of 5.8 mg/L detected in filter bed area monitoring well 039-08 (Table 3). The NYS AWQS for nitrate is 10 mg/L. No volatile organic compounds attributable to BNL operations were detected in any of the monitoring wells.

## Environmental TLDs

Measurements of environmental background radiation are conducted through a network of on- and off-site environmental thermoluminescent dosimeters (TLDs). The TLDs allow for the measurement of radiation from cosmic and terrestrial sources, as well as any contribution from Laboratory operations. One TLD, station S5, is located at the STP and exchanged on a quarterly basis. The ambient dose rates for the four quarters of 2004 were 18.5, 14.7, 14.5, and 16.3 mrem, respectively. The annual average dose at this location was  $64 \pm 15$  mrem, which is similar to the normal background dose.

## Future Monitoring Actions

The monitoring program for 2005 will consist of the following:

- The SPDES monitoring program will continue per permit requirements which were renewed through February 28, 2010.
- Groundwater monitoring program for the filter bed area wells will be maintained on its current semiannual schedule. Monitoring frequency for the holding pond area wells will be reduced to annual.
- Continue the TLD monitoring program on its current schedule.

## References

- BNL. 2004. *Brookhaven National Laboratory Environmental Monitoring Plan, Annual Update*. BNL-52676. Brookhaven National Laboratory, Upton, NY. January 2004.
- DOE Order 5400.5. 1990. *Radiation Protection of the Public and the Environment*. U.S. Department of Energy, Washington, D.C. Change 2: 1-7-93.

Table 1. SPDES Monitoring Program for the Sewage Treatment Plant, CY 2004.

Analyte	Min.	Max.	Min. Monitoring Frequency	SPDES Limit	Limit Exceeded	% Compliance*
Max. Temperature (°F)	48	84	Daily	90	0	100
pH (SU)	5.9	7.7	Continuous Recorder	5.8/9.0	0	100
Avg. 5-Day BOD (mg/L)	< 2	< 2	Twice Monthly	10	0	100
Max. 5-Day BOD (mg/L)	< 2	< 2	Twice Monthly	20	0	100
% BOD Removal	> 94	> 99	Monthly	85	0	100
Avg. TSS (mg/L)	< 1.0	14 <sup>(a,c)</sup>	Twice Monthly	10	0	100
Max. TSS (mg/L)	< 1.0	18	Twice Monthly	20	0	100
% TSS Removal	> 82 <sup>(a,c)</sup>	> 99	Monthly	85	0	100
Settleable Solids (ml/L)	0.0	0.0	Daily	0.1	0	100
Ammonia Nitrogen (mg/L)	< 0.10	0.6	Twice Monthly	2	0	100
Total Nitrogen (mg/L)	3.3	9.9	Twice Monthly	10	0	100
Total Phosphorus (mg/L)	0.37	2.3	Twice Monthly	NA	0	100
Cyanide (µg/L)	< 5.0	18.7	Twice Monthly	100	0	100
Copper (mg/L)	0.035	0.057	Twice Monthly	0.15	0	100
Iron (mg/L)	0.10	0.87 <sup>(b,c)</sup>	Twice Monthly	0.37	1	96
Lead (mg/L)	< 0.0030	0.0074	Twice Monthly	0.019	0	100
Nickel (mg/L)	0.0034	0.024	Twice Monthly	0.11	0	100
Silver (mg/L)	0.0016	0.0054	Twice Monthly	0.015	0	100
Zinc (mg/L)	0.03	0.1	Twice Monthly	0.1	0	100
Mercury (mg/L)	< 0.0002	0.0002	Twice Monthly	0.0008	0	100
Toluene (µg/L)	< 1.0	< 5.0	Twice Monthly	5	0	100
Methylene Chloride (µg/L)	< 1.0	11.0 <sup>(d)</sup>	Twice Monthly	5	0	100
1,1,1-Trichloroethane (µg/L)	< 1.0	< 5.0	Twice Monthly	5	0	100
2-Butanone (µg/L)	< 2.0	9.8	Twice Monthly	50	0	100
PCBs (µg/L)	< 0.065	< 0.65	Quarterly	NA	0	100
Max. Flow (MGD)	0.31	0.67	Continuous Recorder	2.3	0	100
Avg. Flow (MGD)	0.25	0.49	Continuous Recorder	NA	0	100
Avg. Fecal Coliform (MPN/100 ml)	< 2	2	Twice Monthly	200	0	100
Max Fecal Coliform (MPN/100 ml)	< 2	2	Twice Monthly	400	0	100

## Notes:

\*% Compliance = [(total no. samples – total no. exceedances)/ total no. of samples] x 100

BOD = Biological Oxygen Demand

MGD = Million Gallons per Day

MPN = Most Probable Number

NA = Not Applicable

SU = Standard Unit

TSS = Total Suspended Solids

<sup>(a)</sup> Two composite samples collected on June 4 and June 7, 2004, exhibited total suspended solids concentrations of 18 and 10 mg/L respectively. Due to the elevated concentrations, the average TSS concentration and the calculated percent removal exceeded the permit limits.

<sup>(b)</sup> Two permit exceedances of the total iron concentration occurred on June 4 and June 7, 2004.

<sup>(c)</sup> An investigation into the exceedances found that the sample collection probe was lying on the bottom of the flow channel and was likely collecting sediment.

<sup>(d)</sup> Grab samples collected on April 2, 2004 and May 3, 2004 exceeded the permit limits. An investigation found that the analytical laboratory performing these analyses had a solvent contamination problem and therefore the exceedances are not real.

Table 2. STP Groundwater Monitoring, Radionuclide Results for CY 2004

## Filter Beds Area

Well	Sample Date	Gross Alpha		Gross Beta		Tritium		Gamma Spec	
		Conc. (mg/L)	MDA	Conc. (mg/L)	MDA	Conc. (mg/L)	MDA	Conc. (mg/L)	MDA
038-02	6/15/04	8.4 ± 2.9	3.1	7.5 ± 2.4	3.1	< 430	430	ND	
	12/8/04	6.3 ± 1.5	1.2	7.0 ± 1.5	1.8	< 310	310	NOR	
038-03	6/23/04	< 1.1	1.1	7.7 ± 1.5	1.4	< 270	270	ND	
	12/9/04	< 1.0	1.0	10 ± 1.7	1.5	< 320	320	ND	
039-07	6/23/04	< 0.99	0.99	1.8 ± 0.8	1.2	< 280	280	ND	
	12/8/04	< 0.93	0.93	< 1.7	1.7	< 310	310	NOR	
039-08	6/15/04	< 0.89	0.89	< 1.8	1.8	< 430	430	ND	
	12/9/04	< 1.2	1.2	1.7 ± 0.9	1.4	< 270	270	ND	
039-86	6/15/04	< 1.3	1.3	5.0 ± 1.4	1.8	< 440	440	ND	
	12/8/04	< 1.3	1.3	5.7 ± 1.4	1.8	< 310	310	ND	
039-87	6/23/04	< 1.2	1.2	5.4 ± 1.3	1.3	< 270	270	NOR	
	12/9/04	< 0.89	0.89	4.1 ± 1.1	1.3	< 320	320	ND	

## Holding Ponds Area

039-88	6/15/04	< 0.87	0.87	< 1.7	1.7	< 430	430	ND	
	12/14/04	< 1.1	1.1	< 1.7	1.7	< 300	300	ND	
039-89	6/15/04	< 0.87	0.87	< 1.7	1.7	< 440	440	ND	
	12/14/04	< 1.1	1.1	1.8 ± 1.1	1.7	< 310	310	ND	
039-90	6/15/04	< 1.0	1.0	< 1.7	1.7	< 430	430	ND	
	12/14/04	< 1.0	1.0	2.0 ± 1.1	1.8	< 300	300	ND	
Typical MDL		1		2		300			
Standard		15		4 mrem (a)		20,000			

NOR = Only naturally occurring radionuclides detected (e.g., potassium-40)

ND = No radionuclides detected

(a): The drinking water standards were changed from 50 pCi/L (concentration based) to 4 mrem (dose based) in late 2003. Because gross beta activity does not specify the radionuclides present, a dose equivalent cannot be calculated for the values in the table.



Table 3: STP Groundwater Monitoring Water Quality Results for 2004

**Filter Beds Area**

Well	Sample Date	Chloride		Nitrate (as N)		Sulfate	
		Conc. (mg/L)	Qual.	Conc. (mg/L)	Qual.	Conc. (mg/L)	Qual.
038-02	6/15/04	3.2		0.5		4.8	
	12/8/04	2.0	J	3.8		6.1	
038-03	6/23/04	5.1		0.8		8.2	
	12/9/04	3.7		1.4		10.7	
039-07	6/23/04	4.5		1.2		13.2	
	12/8/04	2.7	J	1.0		4.2	
039-08	6/15/04	3.4		1.6		6.2	
	12/9/04	4.9		3.0		3.1	
039-86	6/15/04	38.2		5.3		15.2	
	12/8/04	19.6	J	5.8		13.6	
039-87	6/23/04	3.3		0.7		4.3	
	12/9/04	2.7		1.5		7.9	

**Holding Ponds Area**

039-88	6/15/04	2.8		0.1		15.1	
	12/14/04	3.2		1.0		10.1	
039-89	6/15/04	4.9		1.2		8.8	
	12/14/04	4.4		3.0		8.4	
039-90	6/15/04	5.5		2.6		7.9	
	12/14/04	11.4		3.4		8.8	
Typical MDL		4		1		4	
NYSAWQS		250		10		250	

U: Not detected at concentration above the Minimum Detection Limit

J: Estimated Value

Table 4. STP Area Groundwater Monitoring, Metals Results for CY 2004

**Filter Beds Area**

Well	Sample Date	Al	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ag	Na	Zn
		Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)	Conc. (mg/L)
038-02	6/15/04	0.076 J	<0.002	<0.005	<0.01	<0.05	<0.003	0.053	<0.0002	<0.002	3.2	<0.01
	12/8/04	0.053	<0.002	<0.005	<0.01	<0.05	<0.003	<0.005	<0.0002	<0.002	3.4	<0.01
038-03	6/23/04	<0.05	<0.002	<0.005	<0.01	0.11	<0.003	0.064	<0.0002	<0.002	3.3	0.14
	12/9/04	0.031	<0.002	<0.005	<0.01	1.18	<0.003	0.023	<0.0002	<0.002	2.4	0.17
039-07	6/23/04	<0.05	<0.002 E	<0.005	<0.01	<0.05	<0.003	0.009	<0.0002	<0.002	5.9 N	<0.01
	12/8/04	<0.03	<0.002	<0.005	<0.01	<0.05	<0.003	0.005	<0.0002	<0.002	4.0	<0.01
039-08	6/15/04	0.066 J	<0.002	<0.005	<0.01	<0.05	<0.003	0.006	<0.0002	<0.002	5.8	<0.01
	12/9/04	0.416	<0.002	<0.005	<0.01	0.50	<0.003	0.009	<0.0002	<0.002	4.8	<0.01
039-86	6/15/04	0.06 J	<0.002	<0.005	<0.01	0.04	<0.003	0.153	<0.0002	<0.002	27	<0.01
	12/8/04	0.036	<0.002	<0.005	<0.01	0.05	<0.003	0.199	<0.0002	<0.002	28.6	<0.01
039-87	6/23/04	0.054	0.002 E	<0.005	0.098 N	0.06	<0.003	0.029	<0.0002	<0.002	373	0.06
	12/9/04	0.08	<0.002	<0.005	<0.01	0.06	<0.003	0.007	<0.0002	<0.002	2.3	0.03

**Holding Ponds Area**

039-88	6/15/04	0.064 J	<0.002	<0.005	<0.01	<0.05	<0.003	0.02	<0.0002	<0.002	3	<0.01
	12/14/04	<0.03	<0.002	<0.005	<0.01	<0.05	<0.003	0.014	<0.0002	<0.002	2.8	<0.01
039-89	6/15/04	0.072 J	<0.002	<0.005	<0.01	<0.05	<0.003	0.012	<0.0002	<0.002	4.2	<0.01
	12/14/04	0.061	<0.002	<0.005	<0.01	<0.05	<0.003	0.024 E	<0.0002	<0.002	4.2	<0.01
039-90	6/15/04	<0.05	<0.002	<0.005	<0.01	<0.05	<0.003	0.008	<0.0002	<0.002	5.3	<0.01
	12/14/04	<0.03	<0.002	<0.005	<0.01	<0.05	<0.003	<0.005	<0.0002	<0.002	12.3	<0.01
Typical MDL		0.05	0.002	0.005	0.01	0.05	0.003	0.005	0.0002	0.002	0.2	0.01
NYSAWQS		0.2 (a)	0.005	0.05	0.2	0.3	0.025	0.3	0.0007	0.05	20	2

U: Not detected at concentration above the Minimum Detection Limit

B:

(a) Drinking Water Standard – Secondary MCL for aesthetic quality.

(b) NYSDEC Guidance Value

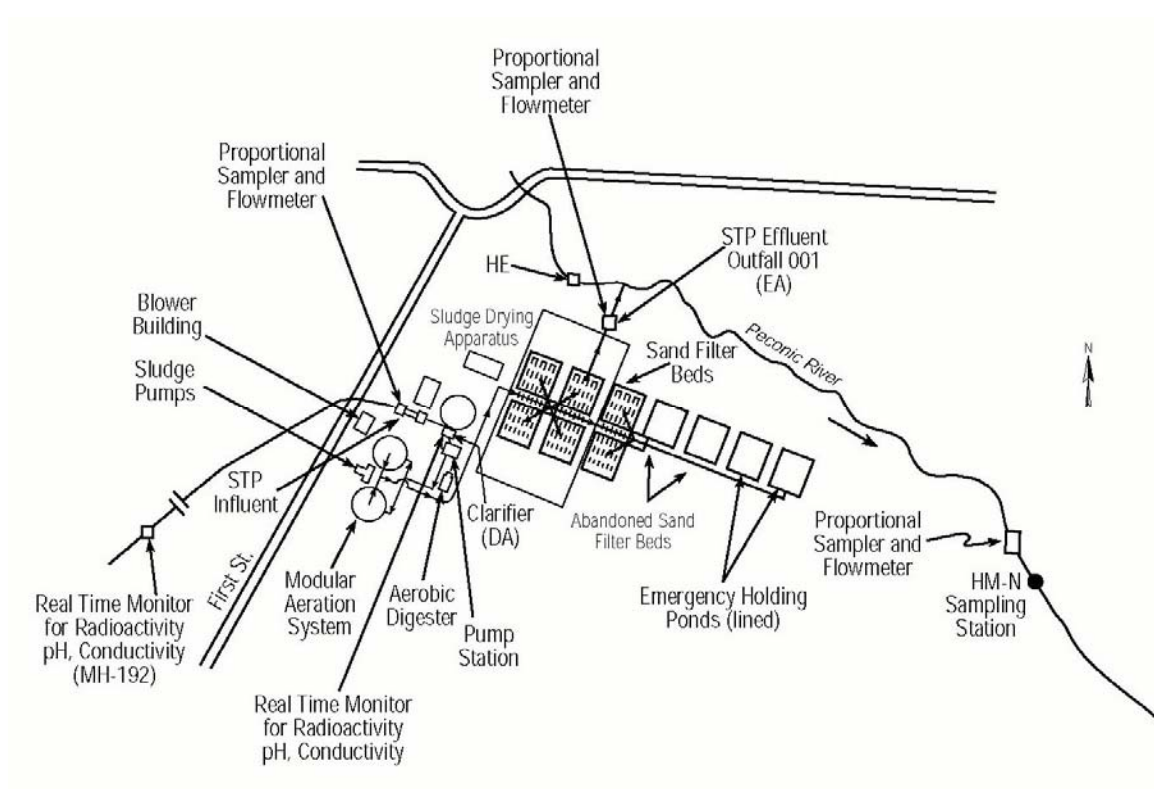


Figure 1. Schematic of the Sewage Treatment Plant.

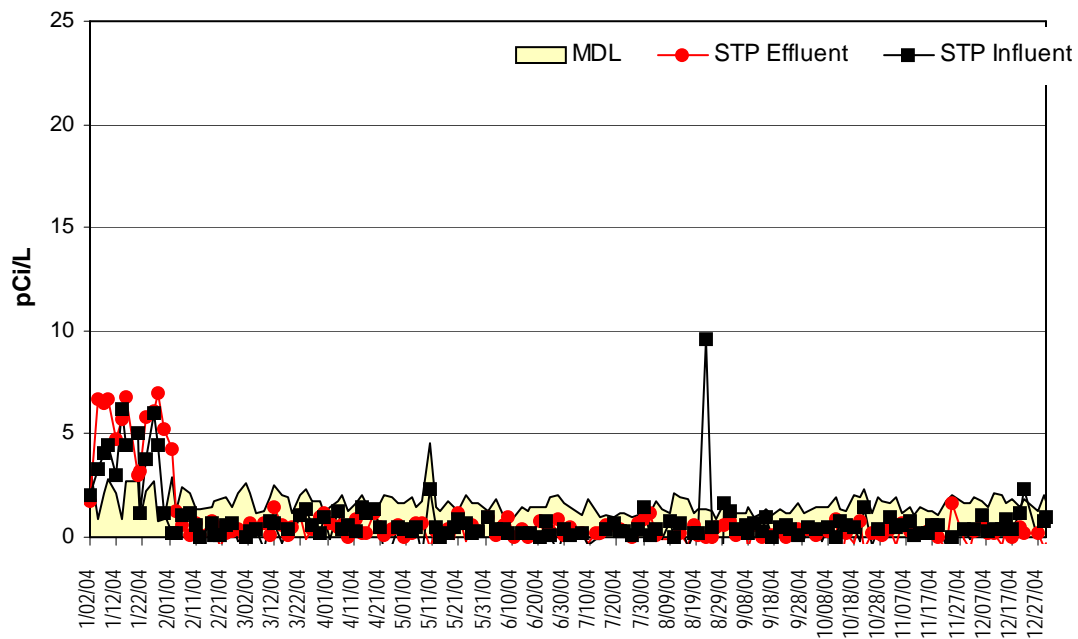


Figure 2. STP Gross Alpha Trend, CY 2004.

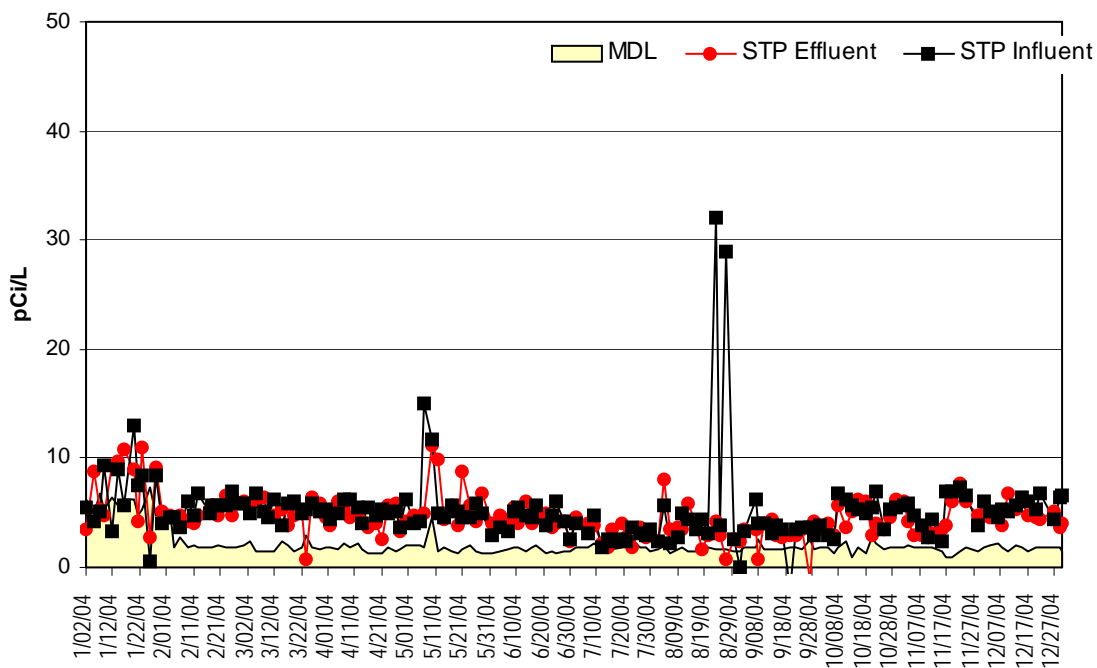


Figure 3. STP Gross Beta Trend, CY 2004.

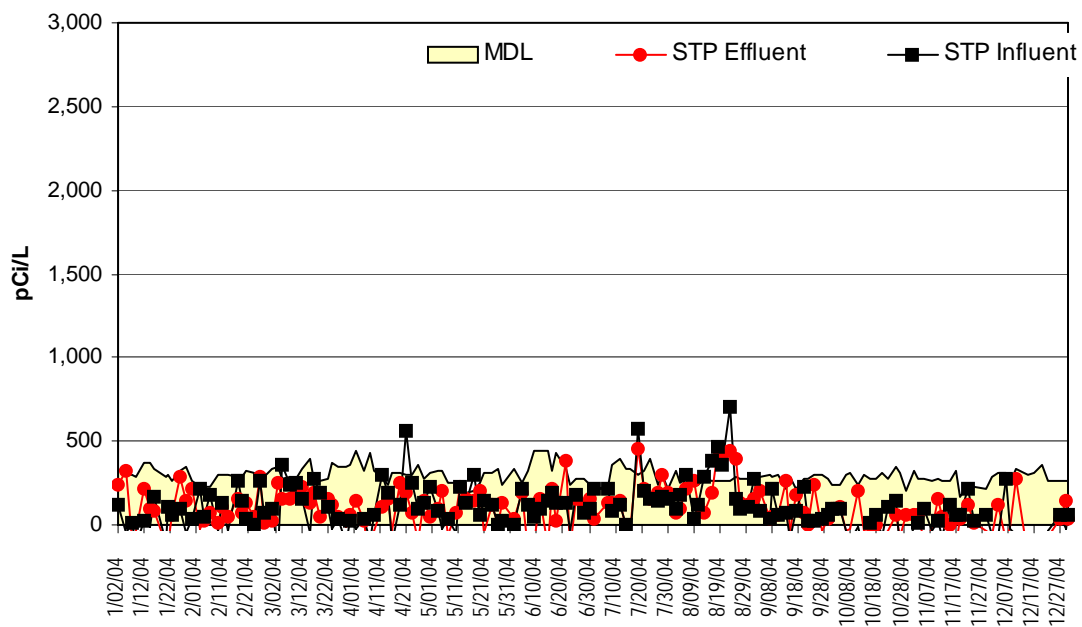


Figure 4. STP Tritium Trend, CY 2004.

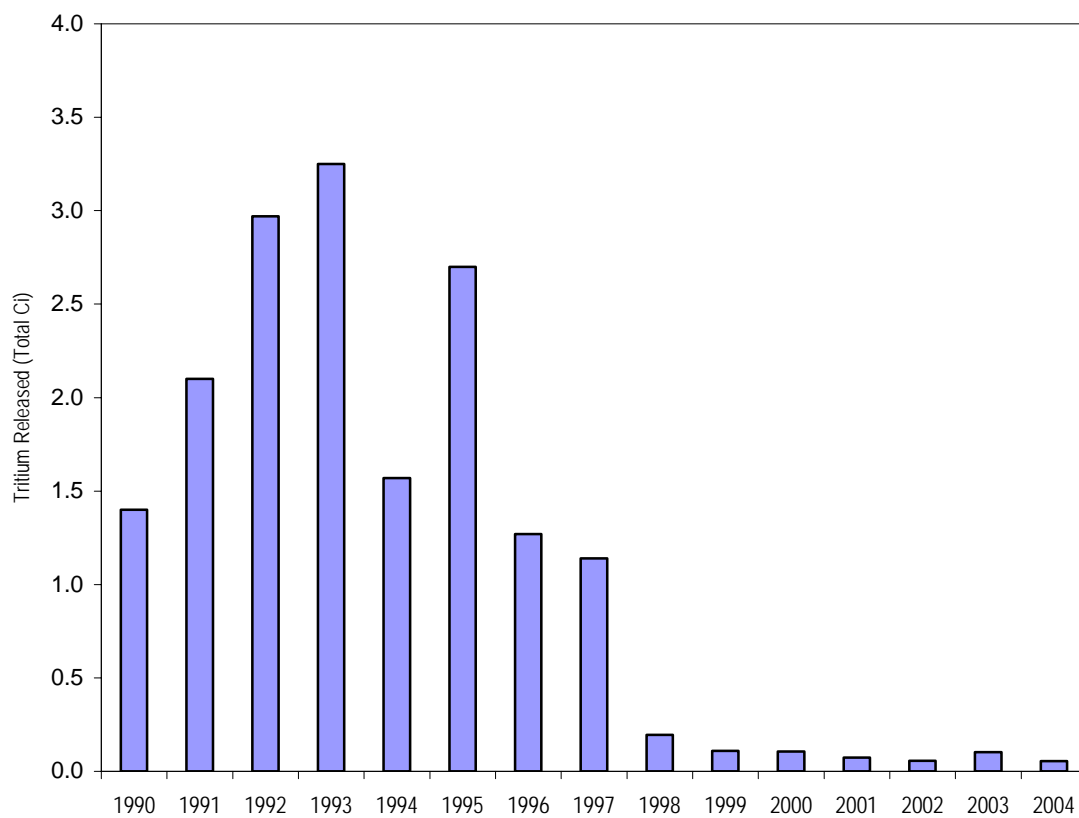


Figure 5. Tritium Released to the Peconic River, 15-yr Trend (1990–2004).

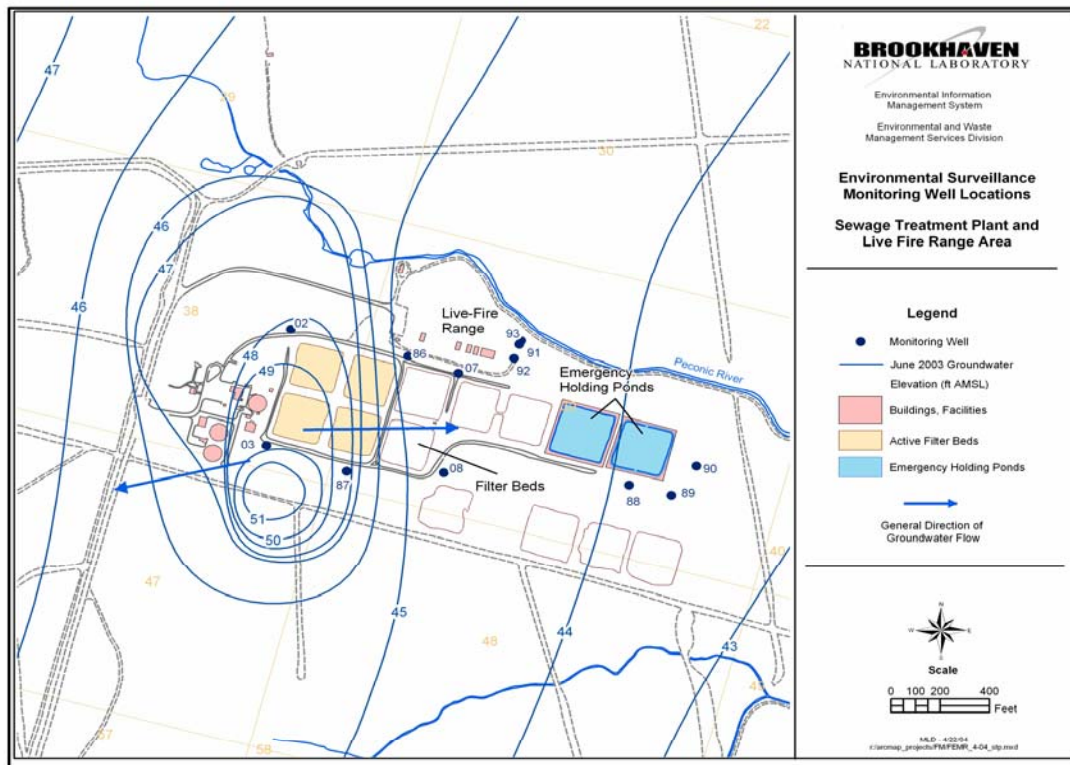


Figure 6. Location of Groundwater Monitoring Wells Near the Sewage Treatment Plant.